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S & T REVIEW

STUDY OF CORRELATION COEFFICIENT AND PATH ANALYSIS AMONG YIELD PARAMETERS OF WHEAT: A REVIEW

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ABSTRACT

Wheat is third most important food crop in Nepal after rice and maize. The productivity of wheat in Nepal is lower than world productivity. The causes behind it are drought and heat stresses, genotype, climate change, global warming lack of inputs and irrigation. Yield of wheat is quantitative trait which is adversely affected by environmental factors. Therefore, only genotypic selection is not effective and selection should be based on performance of yield components and morpho-physiological characters. Correlation coefficient analysis provides the direction and degree of relationship between yield attributing characters. Path coefficient analysis helps to analysis direct and indirect effect of one variable to another. It helps in partitioning direct and indirect causes of correlation. Among agronomic trait, days to booting, days to heading and days to maturity show negative correlation to grain yield but chlorophyll content, plant height, spike/m^2, number of spikelet/spike, number of grain/spike, spike length, spike weight is directly correlate to grain yield .Spike weight, spike length, thousand kernel weight, and number of spike per meter square, number of grains per spike and days to anthesis has direct positive effect on grain yield and plant height, chlorophyll content and days to heading have negative direct effect on grain yield.

KEYWORDS

Agronomic trait, Correlation coefficient, path coefficient, grain yield, wheat

1. INTRODUCTION

Wheat (*Triticum aestivum*) is third most important staple food crop in terms of both area (0.7 million hectare) and production (2 million tons) after rice and maize in Nepal (Krishi Dayari, 2077). Productivity of wheat is 2.85tons/hectare in Nepal which is lower than world's productivity (3.54 tonnes/ha) which is not sufficient to fulfill the present demand (*FAOSTATA*, 2019) . In world, the wheat is at 1st position in terms of production (765.76 million tons) and production area(215.9 million hectare(*FAOSTAT*, 2019). Until 2050, the world requires additional 198 million tons of wheat to meet future demand (Sharma et al., 2015). Low productivity of wheat in Nepal is due to drought and heat stress (Boyer, 1970) (Araus et al., 2002) genotype , climate change ,global warming (Poudel et al., 2020), lack of inputs and irrigation (H. Sharma et al., 2020),soil fertility degradation and biotic stress(Boyer, 1970). When 1°C rise in temperature , 3-4% (3-4 tons) wheat production is reduced (Wardlaw et al., 1989). Yield of wheat is quantitative trait which is adversely affected by environmental factors. Therefore, only genotypic selection isn't effective(N. Khan, 2014),(M. A. Ali et al., 2009) and selection should be based on performance of yield components and morpho-physiological characters (N. Khan, 2014),(Khaliq et al., 2004). Genotypic and phenotypic correlation indicate various morphology and physiological trait which directly depends on yield (Khaliq et al., 2004),(Akram et al., 2008). Ali and shakor (2012), Anwar et.al. (2009), Bhutta et.al (2005) reported that to determine the grain yield of wheat, correlation between grain yield and yield contributing character alone is not sufficient to indicate relation between them (I. H. Ali & Shakor, 2012),(Anwar et al., 2009),(Bhutta et al., 2005). Path coefficient analysis helps to provide more information about relation between grain yield and yield attributing character than correlation (Arshad et al., 2006),(Del Moral et al., 1994). Path coefficient analysis helps to analysis direct and indirect effect of one variable to another (Dewey & Lu, 1959). In plant breeding , path coefficient analysis helps plant breeder to select useful trait to improve crop yield (Dewey & Lu, 1959),(Milligan et al., 2003). Grain per spike, spike length, plant height, no of tillers and 1000 kernel weight shows positive correlation with yield per plant (Khaliq et al., 2004)(Akhtar, 1991). However, days to heading, plant height and tillers per plant has negative correlation with yield per plant (Iftikhar et al., 2012). Gelacha and Hanchinal (2013) reported that spike length and grain yield have significant positive correlation with days to maturity(Gelalcha & Hanchinal, 2013). Mohammadi et al. (2012), Tsegaye et al. (2012) and Zafarnaderi et al. (2013) also reported negative correlation relation between days to anthesis and grain yield per plant (Mohammadi et al., 2012),(Tsegaye et al., 2012),(Zafarnaderi et al., 2013). According to Ojha et.al (2018) and Jain et.al (1975), spike per meter square, spike weight, spike length, days to anthesis, TKW (1000 kernel weight) have positive direct effect on grain yield (Yagdi, 2009)(Ojha et al., 2018b),(Jain et al., 1975).However, plant height (Ojha et al., 2018)(Subhani & Chowdhry, 2000)(Aycicek & Yildirim, 2006), chlorophyll content, days to heading, flag leaf length (Ojha et al., 2018) and stomata frequency, leaf venation (Subhani & Chowdhry, 2000) gives negative direct effect on grain yield. Similarly plant height shows indirect effect on grain weight and grain per spike (Subhani & Chowdhry, 2000).

2. DISCUSSION

Grain yield is determined by various complex morphological and physiological process that occur during different stages of plant (Singh et al., 2012). Plant height, spike length, spikelet per spike,and 1000 kernel weight have significant positive correlation at genotypic and phenotypic level(Khaliq et al., 2004),(Akhtar, 1991). Similarly this result was found by Mohy-ud-Din (1995) and Narwal et al. (1999 (Narwal et al., 1990),(Mohy–ud–Din, 1995).Correlation coefficient analysis is used to measure the direct positive and negative effect of different traits.(Singh et al., 2012). Correlation coefficient analysis provide the direction and degree of relationship between various yield attributing characters (Kumar et al., 2010). Path coefficient analysis is used for partitioning of direct and indirect causes of correlation (Bhushan et al., 2013). The relationship among grain yield attributing characters is discussed as follows.

2.1 Correlation coefficient

2.1.1 Days to booting

Days to booting shows negative correlation with grain yield, TKW (1000 kernel weight). Its shows positive correlation with days to anthesis, days to heading ,days to maturity and (D. K. Ayer et al., 2017).

2.1.2 Days to heading

Days to heading shows negative correlation with grain yield, chlorophyll content ,TKW ,flag leaf length and harvest index (D. K. Ayer et al., 2017),(Ojha et al., 2018b).Its shows positive correlation with days to anthesis, days to maturity, days to flag leaf senescence ,plant height(D. K. Ayer et al., 2017)

2.1.3 Days to anthesis

1000-kernel weight, plant height, spike length, spike weight, spikelets per spike, flag leaf length, days to heading, grain yield shows positive correlation with days to anthesis(Ojha et al., 2018b). According to Ayer et.al, anthesis is negatively correlated with grain yield and peduncle length (D. K. Ayer et al., 2017).

2.1.4 Days to maturity

TKW, harvest index and grain yield had negative correlation with days to maturity and positive correlation with spike length(D. K. Ayer et al., 2017).

2.1.5. Chlorophyll content

Chlorophyll content is positively significant to grain yield, grain per spike days to maturity and plant height (D. K. Ayer et al., 2017).

2.1.6 Plant height

Peduncle length, spike length, 1000-grain weight, grain weight is directly correlate to plant height (Subhani & Chowdhry, 2000)(D. K. Ayer et al., 2017)(Ojha et al., 2018b). Some studies found that negative correlation between plant height and grain yield (Mohammad et al., 2002). Plant height negative correlation with grain per spike(Ojha et al., 2018b).

2.1.7 Thousand kernel weight

Thousand kernel weight has highly significant and positive association with spike weight, number of grains per spike and ear length at genotypic and phenotypic level (Singh et al., 2012), significant positive correlation association with days to heading and days to maturity at genotypic level (Bhushan et al., 2013) and highly significant and positive association with grain filling duration at both genotypic and phenotypic level (Mecha et al., 2017). It shows negative association with days to heading, days to maturity and number of spikelet per spikes at both genotypic and phenotypic level (Bhushan et al., 2013; Mecha et al., 2017).Kumar et al. (2010) also found positive and significant association of thousand kernel weight with number of tillers, number of spikelet per spike and number of grains per spike. Thousand kernel weight is positively and non-significantly correlated with grain yield at both genotypic and phenotypic level (Akram et al., 2008).

2.18 Spike/m²

Spike per m² is positively and highly associated with number of grain per spike and spike length at both genotypic and phenotypic level (Akram et al., 2008), positive and significant association with plant height (Bhushan et al., 2013) and significant positive correlation with grain yield at phenotypic level (Mecha et al., 2017). It has significant negative association with number of spikelet per spike and grain yield at phenotypic level (Akram et al., 2008). While Mecha et al. (2017) and Bhushan et al. (2013) found highly significant and positive association with grain yield at phenotypic level.

2.1.9 Number of spikelet per spike

Number of spikelet per spike has positive significant association with spike weight and number of grain per spike, positive and non-significant correlation with plant height, spike length, number of productive tillers per m², days to anthesis, 1000-kernel weight, grain yield and days to heading and show negative correlation with chlorophyll content (Dutamo et al., 2015; Ojha et al., 2018a).

2.1.10 Number of grains per spike

Number of grains per spike has strong positive association with ear length and spike weight at genotypic and phenotypic level (Singh et al., 2012). It shows non-significant correlation with thousand kernel weight at phenotypic and genotypic level (Khan & Dar, 2010). Number of grains per spike shows highly positive and significant association with biomass yield (Mecha et al., 2017).

2.1.11 Spike length

Ear length is positively correlated with productive tillers/plant both at genotypic and phenotypic level (Singh et al., 2012). Ayer et al. (2017) found positive correlation with grain yield, significant and negative association with thousand kernel weight and non-significant negative association with grains per spike. Spike length is positively highly significant with number of spikelet per spike at phenotypic level (Mecha et al., 2017). Sokoto, Abubakar, and Dikko (2012) and Abderrahmane et al. (2013) found positive highly significant association of spike length with grain yield.

2.1.12 Spike weight

Spike weight was positively correlated at both genotypic and phenotypic level with ear length (Singh et al., 2012). Ojha et al. (2018) found positive and significant association of spike weight with spikelets per spike and number of grains per spike, positive but non-significant correlation with days to anthesis, plant height, spike length and grain yield and negative correlation with leaf chlorophyll content, days to heading and thousand kernel weight.

2.1.13 Grain yield

Grain yield has positive and non-significant correlation association with plant height, spike length, spike weight, spikelets per spike, number of grains per spike, days to anthesis, thousand kernel weight and days to heading and negative correlation with chlorophyll content (Okuyama et al., 2004; Aycicek & Yildirim, 2006; Ojha et al., 2018). In contrary Ayer et al. (2017) found positive and highly significant association of grain yield with plant height and negative and non-significant association with days to booting, days to heading and days to anthesis. Z. et al. (2013) found positive and significant association of grain yield with number of productive tiller per m².

2.2 Path analysis

Grain yield is determined by various yield attributing characters which have direct and indirect effect in grain yield (Nasri et al., 2014). The direct effecting traits can be selected in future for better performance of plant (Nasri et al., 2014). Grain yield is considered as dependent variable and other characters are considered as independent variable (Z. et al., 2013). Spike weight, spike length, thousand kernel weight, number of spike per meter square(Aycicek & Yildirim, 2006)(Mohammad et al., 2002),(N. Khan, 2014), number of grains per spike and days to anthesis have direct positive effect on grain yield(Ojha et al., 2018a; Singh et al., 2012). and plant height, chlorophyll content and days to heading have negative direct effect on grain yield (Ojha et al., 2018a; Singh et al., 2012). Plant height, number of grains per spike and thousand kernel weight show non-significant effect on grain yield (Nasri et al., 2014). Ayer et al. (2017) found indirect effect of days to flag leaf emergence, days to booting and days to heading in grain yield. Days to maturity is direct effect on grain yield (Gelalcha & Hanchinal, 2013).Under anthesis stress condition path coefficient analysis exhibit that spike length almost negligible to grain yield (N. Khan, 2014).

3. Conclusion

Grain yield of wheat is determined by many yield attributing characters. These yield attributing characters have both positive and negative correlation with grain yield. During selection of wheat genotype we should know about performance of different characters and relation among these characters. The direct effecting traits and positively correlated traits should be selected in future for better performance of plant.

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